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## Medical end-of-life decisions in the oldest old in Switzerland

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**Abstract:** AIMS OF THE STUDY: To analyse medical end-of-life decision making among the oldest old (80+ years) in Switzerland, focusing not only on treatments withheld or withdrawn but also on those continued until death. **METHODS:** This was a retrospective follow-up study of deaths registered in Switzerland between August 2013 and January 2014 using a standardised questionnaire completed by the attending physician. All individuals aged 65 years and older who did not die suddenly and completely unexpectedly, and who had met the responding physician prior to death were included (n = 2842). We examined three age groups: 65ndash;79, 80ndash;89, and 90+ years. Logistic regression analysis was used to identify age-related differences, controlled for place of death and sociodemographic characteristics. **RESULTS:** In 83.8% of the study population at least one medical end-of-life decision was made, and for 39.4% the use of a potentially life-sustaining treatment was documented. Alleviation of pain and other symptoms with a possible life-shortening effect was performed with 29% higher odds among the 90+-year-olds (odds ratio [OR] 1.29, 95% confidence interval [CI] 1.01ndash;1.66) than in the youngest age group. Withholding or withdrawing potentially life-sustaining treatment with or without the explicit intention to hasten death did not differ with age. However, when the frequency of withholding a potentially life-sustaining treatment was compared with the frequency of using this treatment (either continued until death or withdrawn later on), the former was more common in old age (80ndash;89 years), and particularly in very old age (90+ years) for most of the treatments studied. This applied especially for ventilator therapy (80ndash;89 years: OR 2.83, 95% CI 1.82ndash;4.41; 90+ years: OR 6.17, 95% CI 2.89ndash;13.17, compared with 65ndash;79 years), artificial nutrition (ORs 2.33, 95% CI 1.46ndash;3.71 and 4.44, 95% CI 2.28ndash;8.65, respectively), and antibiotics (ORs 1.53, 95% CI 1.11ndash;2.09 and 1.57, 95% CI 1.05ndash;2.35, respectively). Age had no independent impact on artificial hydration. **CONCLUSIONS:** The use of some potentially life-sustaining treatments decreased with older age and, in relation, the relative frequency of withholding such treatments increased. There may be various reasons for this finding: less benefit of a particular treatment in older patients for instance due to comorbidities, higher burden of treatment, and finally a tacit consensus of physicians and patients that death is nearing.

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## Medical end-of-life decisions in the oldest old in Switzerland

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### Summary

**AIMS OF THE STUDY:** To analyse medical end-of-life decision making among the oldest old (80+ years) in Switzerland, focusing not only on treatments withheld or withdrawn but also on those continued until death.

**METHODS:** This was a retrospective follow-up study of deaths registered in Switzerland between August 2013 and January 2014 using a standardised questionnaire completed by the attending physician. All individuals aged 65 years and older who did not die suddenly and completely unexpectedly, and who had met the responding physician prior to death were included (n = 2842). We examined three age groups: 65–79, 80–89, and 90+ years. Logistic regression analysis was used to identify age-related differences, controlled for place of death and sociodemographic characteristics.

**RESULTS:** In 83.8% of the study population at least one medical end-of-life decision was made, and for 39.4% the use of a potentially life-sustaining treatment was documented. Alleviation of pain and other symptoms with a possible life-shortening effect was performed with 29% higher odds among the 90+-year-olds (odds ratio [OR] 1.29, 95% confidence interval [CI] 1.01–1.66) than in the youngest age group. Withholding or withdrawing potentially life-sustaining treatment with or without the explicit intention to hasten death did not differ with age. However, when the frequency of withholding a potentially life-sustaining treatment was compared with the frequency of using this treatment (either continued until death or withdrawn later on), the former was more common in old age (80–89 years), and particularly in very old age (90+ years) for most of the treatments studied. This applied especially for ventilator therapy (80–89 years: OR 2.83, 95% CI 1.82–4.41; 90+ years: OR 6.17, 95% CI 2.89–13.17, compared with 65–79 years), artificial nutrition (ORs 2.33, 95% CI 1.46–3.71 and 4.44, 95% CI 2.28–8.65, respectively), and antibiotics (ORs 1.53, 95% CI 1.11–2.09 and 1.57,

95% CI 1.05–2.35, respectively). Age had no independent impact on artificial hydration.

**CONCLUSIONS:** The use of some potentially life-sustaining treatments decreased with older age and, in relation, the relative frequency of withholding such treatments increased. There may be various reasons for this finding: less benefit of a particular treatment in older patients for instance due to comorbidities, higher burden of treatment, and finally a tacit consensus of physicians and patients that death is nearing.

**Keywords:** end-of-life care, palliative care, alleviation of pain and other symptoms, non-treatment decisions, withholding and withdrawing treatment, continuing treatment, age

### Introduction

As a result of demographic aging in developed countries, the proportion of deaths of patients aged 80 years or older has risen sharply in recent decades. In Switzerland, this proportion has now reached over one half of all deaths in men and more than two thirds of all deaths in women [1]. The aging of the population as well as medical technological developments occur alongside changes in medical care and decision making at the end of life [2]. There is little information available on the circumstances and quality of care in the final phase of older patients' lives [3–5]. Particularly for patients aged 90 years or older, there are no specific investigations into the incidence and characteristics of medical end-of-life decisions (MELDs). The oldest old have been reported to have less access to specialist or palliative care, to receive adequate pain and symptom treatment less often, and to be excluded from decision making more often [6]. For this reason, it is highly relevant to gain more insight into what medical decisions are made towards the end of life in these patients and whether age is a determining factor.

MELDS include the administration of drugs to alleviate pain and other symptoms even when such treatment may

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hasten the patient's death (APS), as well as decisions to forgo potentially life-sustaining treatment, namely withholding and/or withdrawing a certain medical therapy. These decisions account for the vast majority of MELDs [2, 7, 8]. Withholding treatment means the decision not to initiate a treatment that is aimed at prolonging life, whereas withdrawing treatment means to discontinue an ongoing treatment [9–12]. Both types of decision can hasten death and thus may create a tension between prolonging life and providing the best possible quality of life. For this reason, despite their frequency in end-of-life care, such decisions are often difficult and stressful for medical health professionals [9, 13, 14].

Several studies have shown that APS was used less often in older patients [3, 15, 16], whereas other studies did not find any age differences [8, 17, 18]. A systematic review by Rietjens et al. [2] showed that in most of the studies reviewed, APS was used less often in the 80+-year-olds, but the overall effect was not significant. According to several studies, forgoing potentially life-sustaining treatment occurred more often in older patients (80+) than in younger ones [2, 8, 9, 16–20]. In older patients, withholding treatment was generally more frequent than withdrawing treatment [21]. Other studies found that age is unrelated to the frequency of end-of-life decisions in general [15, 22, 23] and that the incidence of forgoing treatment in particular did not significantly differ with age [3, 15]. But many of these studies did not differentiate between withholding and withdrawing treatment, and none of them considered the treatments that were continued until death. However, it is essential to analyse the frequency of treatments withdrawn in relation to the total number of treatments given, that is, cases in which a treatment was withdrawn plus cases in which that treatment was continued until death. We therefore chose a new approach and compared withholding treatment not only with withdrawing but also with continuing it [24]. For this purpose, we restricted our analyses to non-sudden, expected deaths since only these cases were eligible for an MELD.

The first aim of our study was to describe the incidences of intensified APS and of treatments withheld/withdrawn among the oldest old patients in Switzerland prior to death and to analyse whether they differ with age. The second aim was to study whether age impacts the frequency of withholding, withdrawing and continuing specific types of treatment.

## Methods

### Data collection

Between 1 August 2013 and 31 January 2014, the Swiss Federal Statistical Office weekly drew a random sample of death certificates, encompassing 21.3% of deaths of people aged 1 year or older in the German-speaking part of Switzerland, 41.1% in the French-speaking part and 62.9% in the Italian-speaking part. Certifying physicians were sent a total of 8963 questionnaires, of which 3173 (63.5%), 1538 (51.9%) and 617 (61.7%) were returned from the German-, French-, and Italian-speaking regions, respectively, up to 11 June 2014. To ensure anonymity of both patients and physicians, the questionnaires were sent

to the Swiss Academy of Medical Science where they were anonymised before being made available for research.

### Survey

The standardised survey collected information about MELDs regarding the patient, as well as physician demographic information. Physicians were asked to indicate when they had first encountered the patient (including possibly not until after death) and whether death had been sudden and completely unexpected. Further questions inquired after treatment decisions made at the end of life and the decision-making process. Multiple-choice questions asked about specific treatments that were continued until death, or withheld or withdrawn before death. Demographic information about the patient was collected from the death certificate. More details are given elsewhere [23].

### Sample

We included all people aged 65 years or older at the time of death who did not die suddenly and completely unexpectedly as assessed by the responding physician ( $n = 3678$ ). We excluded those who died from a physician-assisted death or with whom the responding physician did not have contact before death. Cases without APS where only “other treatment” or “other medications” were continued, withdrawn or withheld were also excluded ( $n = 134$ ). This led to a final sample of  $n = 2842$ .

### Analysis

Data were weighted to adjust for region-, age-, and sex-specific differences in response rates and to ensure the sample was representative of all deaths in the sample period. The regions (German-, French-, and Italian-speaking) were weighted according to their proportion of deaths in the total Swiss population.

Descriptive statistics (weighted %) were used to assess the characteristics of the study population and the frequency of the different MELDs. Multivariable logistic regression (odds ratios [ORs], 95% confidence intervals [CIs]) was used to test the association between patient and care characteristics and odds of specific MELDs. All analyses were adjusted for sex, marital status, cause of death, and place of death. Deceased persons were classified into three age groups: 65–79 (reference group), 80–89, and 90+ years old. Study methods have been described in more detail elsewhere [25].

### Ethics

The study was issued a waiver as being unproblematic by the Zurich Cantonal Ethics Board (KEK-StV-Nr. 23/13).

## Results

### Description of the study population

Mean age of the study population was 83.8 years (95% CI 83.5–84.2; [table 1](#)). There were slightly more women than men (56.4%) with the percentage rising with age: 43.7% in the youngest age group, 56.6% in the intermediate group and 69.1% in the oldest one. Overall, 37.5% of all patients were married, with the proportion decreasing with age (57.8%, 38.7%, and 14.5%, respectively).

In the youngest age group, the most common cause of death was neoplasm (47.7%). This proportion decreased with age (23.6% in the 80–89-year-olds, 12.7% in the 90+-year-olds). On the other hand, there was an increase in cardiovascular diseases with age (16.2% in the 65–79-year-olds vs 26.4% in the 80–89-year-olds and 33.4% in the 90+-year-olds) and a smaller increase of diseases of the nervous system (13.6 vs 21.6 and 23.7%, respectively). Respiratory disease was rarer (11.2% of all cases) and did not substantially vary across age groups. The same was true for “other or unknown” diagnoses (16.0% of all cases).

The most common places of death were hospital (37.7%) and nursing home (35.2%), followed by elderly care residence (12.9%), home (9.6%), palliative care unit (4.3%) and “other” (0.3%). The youngest patients were most likely to die in a hospital (54.1%), whereas patients aged 90 years or older were most likely to die in a nursing home (50.5%).

### Incidence of MELDs

In 83.8% of all individuals in our study population at least one MELD was made, and the proportion slightly increased with age (81.7 vs 84.6 vs 84.8%; [table 1](#)). However, this increase was not significant in logistic regression analysis controlling for place of death and sociodemographic characteristics (OR 1.24, 95% CI 0.96–1.60 for the 80–89-year-olds and OR 1.28, 95% CI 0.94–1.74 for the 90+-year-olds compared with the 65–79-year-olds; [table 2](#)). There were no significant differences in the frequency of at least one MELD between different causes of death, places of death or regarding sex and marital status.

The use of intensified APS slightly increased with age (67.2% in the youngest vs 68.9% in the second and 70.3% in the oldest group; [table 1](#)). Logistic regression ([table 2](#)) showed that the increase was significant for the oldest group compared with the youngest one (OR 1.29, 95% CI 1.01–1.66), but not for the second age group (OR 1.16, 95% CI 0.95–1.43).

Patients who died from non-cancer causes were less likely to receive APS than those who died from cancer, although the difference was only significant for diseases of the nervous system (OR 0.77, 95% CI 0.60–0.99). The frequency of APS was similar in all settings, ranging from 66.2 to 69.6% (compared with hospital deaths: OR 0.83, 95% CI 0.66–1.03 for home deaths and OR 0.99, 95% CI 0.80–1.22 for nursing home deaths).

Withholding or withdrawing a potentially life-sustaining treatment occurred most often in the 80–89-year-olds (72.3%), followed by the 65–79-year-olds (69.7%), and the 90+-year-olds (69.1%). However, logistic regression showed no significant age-related differences (OR 1.12, 95% CI 0.91–1.38 for the 80–89-year-olds and OR 0.97, 95% CI 0.75–1.24 for the 90+-year-olds). Regarding the different causes of death, 76.0% of all patients with diseases of the nervous system and 74.9% of all patients with “other or unknown” diagnoses had a decision to withhold or withdraw treatment, which was significantly more common than in cancer patients (OR 1.50, 95% CI 1.15–1.95 and OR 1.37, 95% CI 1.04–1.81, respectively). No significant differences were found for the other causes of death (OR 1.03, 95% CI 0.82–1.30 for cardiovascular diseases and OR 0.97, 95% CI 0.73–1.30 for respiratory diseases). When the different settings were compared, the frequency of withholding or withdrawing treatment was significantly

**Table 1:** Characteristics of the study population (n = 2842).

		All (65–90+) n = 2842	65–79 n = 835	80–89 n = 1242	90+ n = 765
		n (%)	n (%)	n (%)	n (%)
Age (years), mean (95% CI)		83.8 (83.5–84.2)			
Sex	Male	1271 (43.6%)	467 (56.3%)	565 (43.4%)	239 (30.9%)
	Female	1571 (56.4%)	368 (43.7%)	677 (56.6%)	526 (69.1%)
Marital status	Married	1081 (37.5%)	484 (57.8%)	485 (38.7%)	112 (14.5%)
	Unmarried*	1761 (62.5%)	351 (42.2%)	757 (61.3%)	653 (85.5%)
Cause of death	Neoplasm	819 (27.5%)	404 (47.7%)	311 (23.6%)	104 (12.7%)
	Cardiovascular disease	707 (25.4%)	139 (16.2%)	318 (26.4%)	250 (33.4%)
	Respiratory disease	333 (11.2%)	91 (11.0%)	147 (11.3%)	95 (11.3%)
	Disease of the nervous system	553 (19.9%)	108 (13.6%)	268 (21.6%)	177 (23.7%)
	Other or unknown	430 (16.0%)	93 (11.5%)	198 (17.0%)	139 (19.0%)
Place of death	Hospital	1102 (37.7%)	467 (54.1%)	468 (37.0%)	167 (22.0%)
	Palliative care unit	117 (4.3%)	71 (9.2%)	37 (3.1%)	9 (1.2%)
	Nursing home	955 (35.2%)	153 (19.7%)	430 (35.8%)	372 (50.5%)
	Elderly care residence	382 (12.9%)	47 (5.4%)	182 (14.3%)	153 (18.5%)
	Home	279 (9.6%)	95 (11.4%)	121 (9.5%)	63 (7.7%)
	Other	7 (0.3%)	2 (0.3%)	4 (0.3%)	1 (0.2%)
MELDs	Any MELD	2350 (83.8%)	678 (81.7%)	1031 (84.6%)	641 (84.8%)
	Intensified APS	1941 (68.8%)	560 (67.2%)	850 (68.9%)	531 (70.3%)
	Any potentially life-sustaining treatment withheld/withdrawn	1959 (70.7%)	577 (69.7%)	866 (72.3%)	516 (69.1%)
	Any potentially life-sustaining treatment continued/withdrawn	1195 (39.4%)	449 (52.2%)	498 (37.7%)	248 (28.9%)
	Any potentially life-sustaining treatment continued until death	897 (29.2%)	334 (38.8%)	380 (28.4%)	183 (20.4%)

APS = alleviation of pain and other symptoms; CI = confidence interval; MELD = medical end-of-life decision Unweighted n, weighted % \* Includes single, divorced, widowed, and “other”.



less likely at home (65.9%) than in hospitals (71.8%; OR 0.75, 95% CI 0.60–0.94), and as likely in nursing homes (72.4%) as in hospitals (OR 0.98, 95% CI 0.79–1.21).

The decision to apply a potentially life-sustaining treatment that was either withdrawn later or continued until death was made in 39.4% of all patients, with rates decreasing with increasing age (52.2% in the 65–79-year-olds, 37.7% in the 80–89-year-olds, and 28.9% in the 90+-year-olds). In 29.2% of all patients such a treatment was continued until death – a proportion that also decreased with age (38.8% in the 65–79-year-olds, 28.4% in the 80–89-year-olds, and 20.4% in the 90+-year-olds).

When analysing the frequency of withholding/withdrawing treatment with and without the explicit intention of hastening death separately, we found no significant age pattern for either group (not shown in table).

### Types of treatment withheld, withdrawn or continued until death

Figure 1 shows the weighted percentages of withholding, withdrawing and continuing all nine specific types of treatment for the three age groups separately. All treatments were attempted most often in the youngest age group. There was a clear and consistent decrease with age of treatment attempts in artificial hydration and nutrition, antibiotics, ventilator therapy, chemotherapy and dialysis. For surgery, blood products and radiotherapy the proportion increased slightly in the oldest age group compared with the middle group. But for all these treatments, case numbers in older patients were low. The proportions of withdrawing an already attempted treatment were approximately the same for all age groups across all types of treatment. Withholding a treatment was clearly more frequent than withdrawing the same treatment for all types of treatment in all age categories. Furthermore, withholding a therapy was more common than attempting (withdrawing plus continuing) the same therapy for all types of treatment in all age groups except for artificial hydration and antibiotics, which were given more frequently than withheld in the youngest age group, and artificial hydration, which was withheld about

as often as given in the second age group. The proportions of patients for whom a specific treatment was taken into consideration (sum of continued, withdrawn and withheld) decreased with age for all types of treatment except for artificial nutrition and surgery. The decrease with age was most pronounced in chemotherapy and ventilator therapy.

The four most common types of treatment were artificial hydration, antibiotics, artificial nutrition and ventilator therapy. These four treatments were analysed in more detail by comparing the frequency of withholding the different therapies to withdrawing or continuing them (table 3). The greatest increase with age was found for ventilator therapy. The 80–89-year-olds were nearly three times as likely to have ventilator therapy withheld rather than withdrawn or continued than the 65–79-year-olds (OR 2.83, 95% CI 1.82–4.41). The 90+-year-olds were six times as likely (OR 6.17, 95% CI 2.89–13.17). A clear increase with age was also found for artificial nutrition (OR 2.33, 95% CI 1.46–3.71 and OR 4.44, 95% CI 2.28–8.65, respectively), as well as for antibiotics (OR 1.53, 95% CI 1.11–2.09 and OR 1.57, 95% CI 1.05–2.35, respectively). Age had no independent influence on artificial hydration (OR 1.05, 95% CI 0.71–1.54 for the 80–89-year-olds and OR 0.95, 95% CI 0.61–1.47 for the 90+-year-olds).

Place of death had a very strong impact on all four types of treatment and all of them were more often withheld at home or in nursing homes than in the hospital. This was especially true for artificial hydration, which was withheld about 30 times more often at home (OR 29.26, 95% CI 20.09–42.60) or in nursing homes (OR 32.64, 95% CI 22.25–47.89) than in the hospital.

With respect to cause of death, there was a significant association between the underlying disease and any of the four types of treatment. A decision to withhold rather than attempt ventilator therapy and artificial nutrition was significantly less common in patients who died from non-cancer causes than those who died from cancer. For antibiotics and artificial hydration, the proportion was significantly lower only for cardiovascular and respiratory diseases compared with cancer.

**Table 2:** Age and other determinants of medical end-of-life decisions<sup>\*</sup>: multi-variable logistic regression (n = 2842).

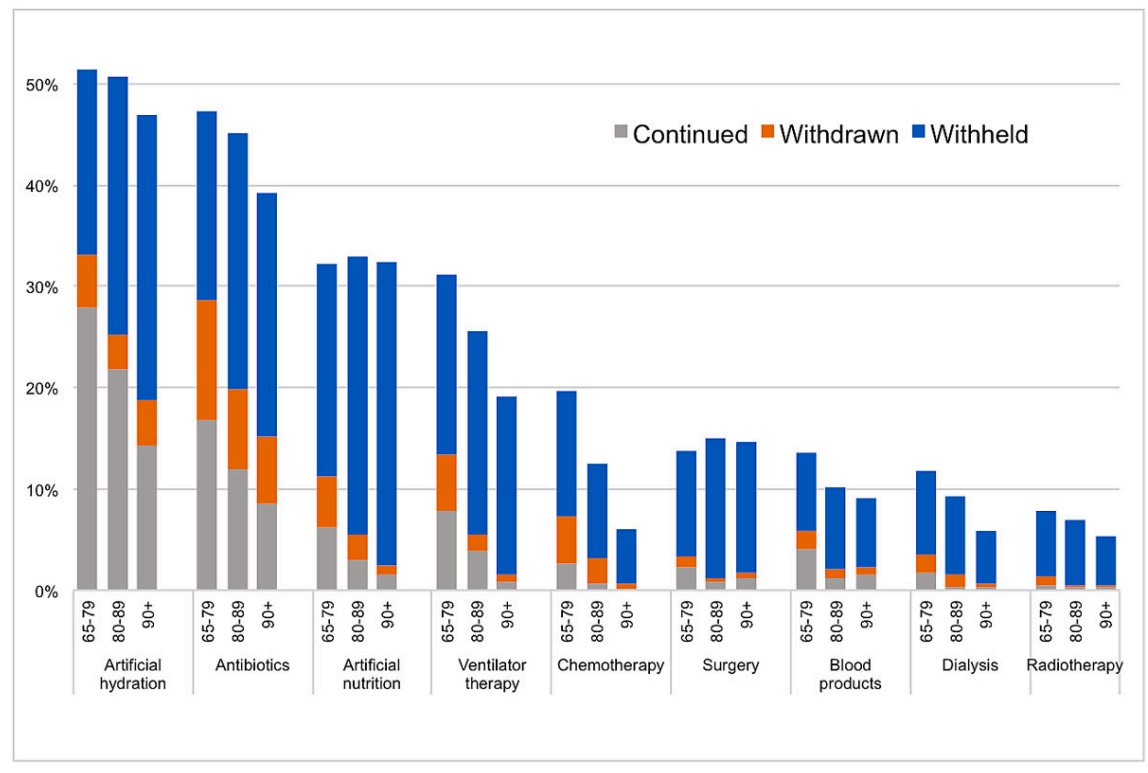
		Any MELD <sup>†</sup> n = 2350		Treatments withheld/withdrawn <sup>†</sup> n = 1959		APS <sup>†</sup> n = 1941	
		n (%) <sup>‡</sup>	OR (95% CI)	n (%) <sup>‡</sup>	OR (95% CI)	n (%) <sup>‡</sup>	OR (95% CI)
Age (years)	65–79	678 (81.7%)	Ref.	577 (69.7%)	Ref.	560 (67.2%)	Ref.
	80–89	1031 (84.6%)	1.24 (0.96–1.60)	866 (72.3%)	1.12 (0.91–1.38)	850 (68.9%)	1.16 (0.95–1.43)
	90+	641 (84.7%)	1.28 (0.94–1.74)	516 (69.1%)	0.97 (0.75–1.24)	531 (70.3%)	<b>1.29 (1.01–1.66)</b>
Sex	Male	1032 (82.6%)	Ref.	874 (70.7%)	Ref.	858 (68.3%)	Ref.
	Female	1318 (84.7%)	1.21 (0.96–1.52)	1085 (70.7%)	1.01 (0.84–1.21)	1083 (69.2%)	1.06 (0.88–1.27)
Marital status	Unmarried <sup>§</sup>	1452 (83.4%)	Ref.	1206 (70.1%)	Ref.	1201 (68.7%)	Ref.
	Married	898 (84.4%)	1.27 (0.99–1.63)	753 (71.6%)	1.08 (0.88–1.32)	740 (68.9%)	1.07 (0.88–1.30)
Cause of death	Neoplasm	666 (82.3%)	Ref.	538 (68.1%)	Ref.	586 (71.4%)	Ref.
	Cardiovascular disease	576 (83.0%)	0.99 (0.75–1.32)	472 (68.1%)	1.03 (0.82–1.30)	474 (68.4%)	0.82 (0.65–1.04)
	Respiratory disease	274 (83.6%)	1.05 (0.74–1.49)	221 (67.4%)	0.97 (0.73–1.30)	222 (68.0%)	0.82 (0.61–1.09)
	Disease of the nervous system	468 (85.0%)	1.10 (0.80–1.51)	413 (76.0%)	<b>1.50 (1.15–1.95)</b>	370 (67.2%)	<b>0.77 (0.60–0.99)</b>
	Other or unknown	366 (86.2%)	1.22 (0.87–1.72)	315 (74.9%)	<b>1.37 (1.04–1.81)</b>	289 (67.4%)	0.77 (0.59–1.01)
Place of death <sup>¶</sup>	Hospital	1009 (83.8%)	Ref.	859 (71.8%)	Ref.	839 (69.6%)	Ref.
	Home	531 (80.8%)	0.78 (0.60–1.02)	424 (65.9%)	<b>0.75 (0.60–0.94)</b>	442 (66.2%)	0.83 (0.66–1.03)
	Nursing home	810 (85.8%)	1.10 (0.85–1.43)	676 (72.4%)	0.98 (0.79–1.21)	660 (69.6%)	0.99 (0.80–1.22)

APS = alleviation of pain and other symptoms; CI = confidence interval; MELD = medical end-of-life decisions; OR = odds ratio \* Mutually adjusted for all other listed variables † Patients with treatments withheld/withdrawn and APS combined are included in all three regression models ‡ Unweighted n, weighted % (percentage of MELD) § Includes single, divorced, widowed and "other" ¶ Home includes elderly care residence and "other". Hospital includes palliative care unit

Withholding ventilator therapy instead of attempting it was significantly more common among women (OR 1.54, 95% CI 1.01–2.36), whereas no significant sex differences could be found for the three other types of treatment stud-

ied in more detail. Marital status had no significant impact on withholding any of the four treatments.

**Figure 1:** Weighted percentages of cases where treatment was continued, withdrawn, or withheld by age group: 65–79 (n = 835), 80–89 (n = 1242) and 90+ (n = 765) years old.



**Table 3:** Withholding the four most common types of treatment compared to those for whom treatment was continued or withdrawn\*: multi-variable logistic regression.

		Artificial hydration n = 1360		Antibiotics n = 1184		Artificial nutrition n = 853		Ventilator therapy n = 675	
		n (%)†	OR (95% CI)	n (%)†	OR (95% CI)	n (%)†	OR (95% CI)	n (%)†	OR (95% CI)
Age (years)	65–79	141 (35.7%)	Ref.	141 (39.4%)	Ref.	163 (65.0%)	Ref.	135 (56.8%)	Ref.
	80–89	273 (50.2%)	1.05 (0.71–1.54)	278 (56.2%)	<b>1.53</b> (1.11–2.09)	203 (83.5%)	<b>2.33 (1.46–3.71)</b>	220 (78.9%)	<b>2.83 (1.82–4.41)</b>
	90+	189 (60.2%)	0.95 (0.61–1.47)	170 (61.1%)	<b>1.57</b> (1.05–2.35)	204 (92.3%)	<b>4.44 (2.28–8.65)</b>	121 (91.8%)	<b>6.17</b> (2.89–13.17)
Sex	Male	225 (40.0%)	Ref.	251 (45.4%)	Ref.	279 (73.7%)	Ref.	210 (66.0%)	Ref.
	Female	378 (55.2%)	1.19 (0.86–1.64)	338 (58.6%)	1.32 (0.99–1.77)	391 (86.3%)	1.40 (0.93–2.13)	266 (81.0%)	<b>1.54 (1.01–2.36)</b>
Marital status	Unmarried‡	400 (53.9%)	Ref.	380 (54.9%)	Ref.	426 (85.8%)	Ref.	289 (80.2%)	Ref.
	Married	293 (40.3%)	1.00 (0.70–1.42)	209 (48.0%)	1.09 (0.79–1.49)	244 (72.9%)	1.00 (0.64–1.56)	187 (65.7%)	0.94 (0.60–1.47)
Cause of death	Neoplasm	152 (45.4%)	Ref.	146 (52.8%)	Ref.	201 (82.7%)	Ref.	140 (85.6%)	Ref.
	Cardiovascular disease	119 (43.8%)	<b>0.62 (0.41–0.95)</b>	102 (46.9%)	<b>0.51</b> (0.34–0.76)	125 (78.4%)	<b>0.38 (0.21–0.68)</b>	117 (68.0%)	<b>0.25 (0.14–0.46)</b>
	Respiratory disease	61 (43.5%)	<b>0.52 (0.33–0.85)</b>	87 (39.3%)	<b>0.33</b> (0.22–0.50)	59 (79.2%)	<b>0.39 (0.19–0.79)</b>	69 (68.7%)	<b>0.29 (0.14–0.58)</b>
	Disease of the nervous system	185 (66.2%)	0.89 (0.55–1.45)	164 (73.2%)	1.15 (0.73–1.81)	200 (85.9%)	<b>0.45 (0.24–0.84)</b>	93 (77.8%)	<b>0.27 (0.14–0.54)</b>
	Other or unknown	86 (39.7%)	0.93 (0.57–1.54)	90 (48.2%)	0.65 (0.42–1.00)	85 (70.7%)	<b>0.34 (0.18–0.64)</b>	57 (64.6%)	<b>0.24 (0.12–0.49)</b>
Place of death§	Hospital	92 (13.5%)	Ref.	160 (30.4%)	Ref.	219 (62.3%)	Ref.	217 (59.3%)	Ref.
	Home	184 (81.4%)	<b>29.26 (20.09–42.60)</b>	148 (70.6%)	<b>5.24</b> (3.57–7.67)	165 (91.1%)	<b>4.82 (2.73–8.51)</b>	102 (93.0%)	<b>6.36</b> (3.08–13.15)
	Nursing home	327 (83.2%)	<b>32.64 (22.25–47.89)</b>	281 (72.5%)	<b>5.51</b> (3.99–7.60)	286 (94.8%)	<b>8.98 (4.87–16.58)</b>	157 (92.2%)	<b>5.32 (2.88–9.84)</b>

CI = confidence interval; OR = odds ratio \* Mutually adjusted for all other listed variables † Unweighted n, weighted % (percentage of MELD) ‡ Includes single, divorced, widowed and "other" § Home includes elderly care residence and "other". Hospital includes palliative care unit.

## Discussion

To our knowledge, this is the first nationwide study of MELDs that specifically includes and focuses on the oldest old patients while differentiating between withholding, withdrawing, and continuing treatment until death. Our results show a number of substantial age differences in the most common MELDs and confirm that the oldest old patients are not a homogeneous group, but that there are relevant differences between the ages 80–89 and 90+ years.

### Incidence of APS in relation to age

The frequency of APS increased across the three age groups and varied from 67.2% to 70.3%. The increase was significant for the oldest old (90+) compared to the youngest age group (65–79). To the best of our knowledge, this gradient has never been described. Previous studies showed a decreasing use of APS with age [3, 15, 16] or no significant age differences at all [2, 8, 17, 18]. A reason for this discrepancy may be that we compared the 90+ and 80–89-year-old groups with the 65–79-year-old patients, whereas all other studies compared 80+-year-olds to <80-year-olds. In addition, almost all previous studies on APS, with the exception of one [15], assigned to each death only one MELD, namely the decision with the most explicit intention of shortening life, whereas we allowed more than one MELD per case. This may of course contribute to the difference in results. An explanation as to why elderly people received more intensified APS may be that they more often prefer treatment options that aim to provide the best possible quality of life rather than prolonging life at all costs [26]. Our study showed that APS was most frequent in cancer patients, which is in line with findings of other studies [16, 18].

### Incidence of withholding/withdrawing treatment in relation to age

In more than four out of five non-sudden deaths in patients aged 65 years or older, at least one MELD had been made prior to death. The incidence of MELDs in total did not significantly differ with age, which is consistent with previous research [3, 15, 17, 22]. The frequency of withholding/withdrawing treatment did not significantly differ with age, either. Only two previous reports came to the same conclusion [3, 15]. They chose the same approach as we did and included only non-sudden, expected deaths in the denominator. This has been shown to be more valid since only these deaths were eligible for an MELD [3]. Most previous studies found an increasing incidence of withholding/withdrawing treatment with age and most of them included all deaths in the denominator [8, 9, 16, 18]. This approach might skew the data because younger patients may be more likely to die from sudden, unexpected deaths. In addition, the prioritisation of MELDs in nearly all previous studies could be a relevant reason why our study had different results. All studies that found a significant age difference used this method, whereas the only study that permitted more than one MELD per case [15] found no significant age difference in withholding/withdrawing treatment, which is consistent with the approach and result of our study.

In the analysis of decisions with the explicit intention of hastening death, no significant age differences were found.

Seale et al. [22] reported the same finding and Chambaere et al. [15] even showed a decrease in withholding or withdrawing treatment with the intention to hasten death. This indicates that the elderly, who are often considered a vulnerable patient group [2], are not more frequently exposed to withholding or withdrawing treatment with intentional life-shortening. Other studies support this finding, showing that decisions to withhold or withdraw life-prolonging treatment were most often made because there was no chance of improvement and the patient was recognised as being near death, which led to promoting patient comfort as the main goal of treatment [9, 22, 27].

A reason why there were no significant age differences in withholding/withdrawing treatment in general may be that it is a too broad and nonspecific category. The various types of treatment can have very different characteristics regarding the circumstances in which they are used, the potential life-prolonging effect or the burden of treatment [28]. Therefore, we analysed them separately.

### Withholding, withdrawing and continuing different types of treatment

Although the frequency of withholding/withdrawing treatment did not depend on age, significant age differences were found when different types of therapies were analysed separately and when withholding a particular treatment was compared with applying (withdrawing plus continuing) the same treatment. Withholding treatment was generally more common than withdrawing and continuing it for nearly all types of treatment, especially in the oldest patients (90+). This is consistent with findings from other studies [9, 20, 21]. The proportion of patients for whom a particular treatment was attempted clearly decreased with age for nearly all treatments. Increased comorbidity and mortality risk in older age can lead to treatments being considered less promising from the start and therefore being withheld rather than attempted [2, 21]. In addition, older patients often prefer comfort care rather than prolonging life at all costs [9]. Moreover, it has been shown that even after adjustment for patients' care preferences and prognosis, severely ill older patients are treated less aggressively than younger ones [29]. For withholding artificial hydration compared with attempting it, no significant age differences could be found. However, place of death had a strong impact on artificial hydration, which was about 30 times more likely to be withheld at home or in nursing homes than in hospital. The benefits and burdens of the use of artificial hydration in end-of-life care are still controversial [30–32]. There are studies that found no effect of artificial hydration on symptom control, whereas others argue that it is still considered the minimum standard of end-of-life care [24, 33, 34]. Our results suggest that the latter is particularly the case in hospitals.

High-technology treatments with a high potential of being burdensome, such as surgery, oncotherapy, dialysis or radiotherapy, were rarely considered (sum of withholding, withdrawing and continuing) and much more often withheld than withdrawn or continued. This was particularly true for the oldest old patients and corresponds to the current ethical view that therapies with little benefit compared with burden should be avoided [35].



The decision to continue a potentially life-sustaining treatment until death was made less often in older patients, whereas the proportion of treatments withdrawn compared with applied was about the same over all three age groups for all types of treatments. Potentially life-sustaining treatments were less often applied in older patients, which explains why they were less often continued until death: a treatment that has never been used cannot be continued. However, the frequency of withdrawing an already applied treatment did not decrease with age. The decision to withdraw an already applied treatment therefore appears to be not primarily dependent on age, but could also be related to factors such as the current clinical status and the burden of symptoms.

### Strengths and limitations

The mortality follow-back study method used was rated as highly reliable [3, 8, 16–18, 36] and even if the optimal phrasing of the questionnaire is controversial [37, 38], this kind of study is still considered the gold standard for investigating end-of-life decision making on a population level [23]. A strength of the questionnaire is that only descriptive questions were asked and no sensitive terms such as “passive euthanasia” were used [28], since it is known that there are still uncertainties among physicians as to what these terms mean [39–42]. Other methodological strengths were the high response rates (63.5%, 51.9%, and 61.7% in the German-, French-, and Italian-speaking region, respectively) and the large and representative region-wide sample sizes for all deaths in Switzerland in 2013. This allowed us to analyse all age groups up to the oldest old in different settings, to disentangle withdrawing, withholding and continuing treatment, and to examine the individual types of treatment separately. Compared with previous studies, our study therefore provides a highly accurate picture of the end-of-life decisions in the oldest old, providing greater insight into clinical practice.

Nevertheless, some limitations need to be considered. The case numbers for rarer types of treatment, especially among the oldest old patients, were too low for reliable quantitative analyses. Larger studies to assess age differences in the oldest old in all types of treatments are needed. Since the data were collected retrospectively, there is always a risk of memory bias. To minimise this problem, time between death and completion of the questionnaire was kept as short as possible and physicians were able to use the patient’s medical records as a memory aid. Although the response rates were relatively high, there is still the possibility of nonresponse bias, especially since MELDs with a life-shortening effect are a sensitive topic. However, studies that investigated nonresponders showed that nonresponse did not cause sociodemographic distortion and was most often due to a lack of time and not because of more relevant reasons such as the physician’s personal attitude towards end-of-life decisions [22, 23, 43, 44]. Our study is based on self-reports of physicians and therefore depends on their assessment of the situation; however, this approach is the most appropriate to examine their medical end-of-life practices [23]. In addition, we had no information as to whether a decision to withhold, withdraw or continue a therapy was appropriate or whether the decision was in line with patients’ preferences.

And finally, we did not take into account possible regional variations. A previous analysis revealed that MELDs in total and decisions to withhold or withdraw treatment in particular were more common in the German-speaking part of Switzerland than in the French- and Italian-speaking regions. However, no significant regional differences were found for different types of treatment, except for artificial hydration being more likely to be withheld in the German- than in the French-speaking part of Switzerland [24, 25].

### Conclusions

In conclusion, we can state that MELDs were common among patients above the age of 65 years, and that the frequency of any MELD versus none did not significantly vary by age. However, the use of APS significantly increased in patients over 90 years old, which is in line with previous research. The incidence of withholding/withdrawing treatment did not significantly differ with age. However, if one considers that potentially life-sustaining treatments were generally attempted less often in oldest old (80+ years) than in younger old patients (65–79 years), the relative frequency of withholding such treatments increased for most of the treatments studied. Since demographic aging occurs in all developed countries, many of our results may be generalised to other countries.

Nonetheless, it is important to consider that MELDs in themselves do not say anything about the quality of end-of-life care [9]. Our study could not investigate whether certain MELDs contributed to the best possible quality of treatment and dying. Further studies are needed to determine whether MELDs are in line with best care practices, patient’s wishes and best possible quality of life. In addition, insight into the physicians’ understanding of the benefits and burdens of different life-prolonging treatments would be helpful to assess the need for better education in end-of-life care and promote quality of care. A recent analysis of the Swiss 2013 MELD study revealed that the physician’s training in end-of-life care (e.g., country of education or year of graduation) had a significant impact on the frequency of MELDs and the propensity to discuss MELDs with patients and relatives [45]. And lastly, clearer guidelines would be desirable to help physicians understand how to deal with the often challenging decision to withhold, withdraw or continue different treatments in complex situations [21].

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### Potential competing interests

The authors report no conflicts of interest.

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